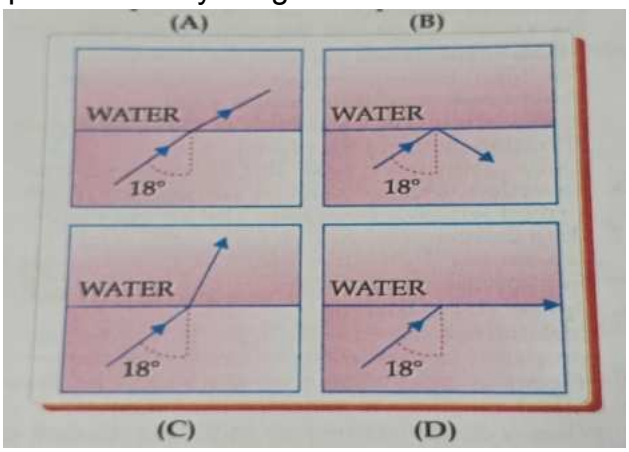
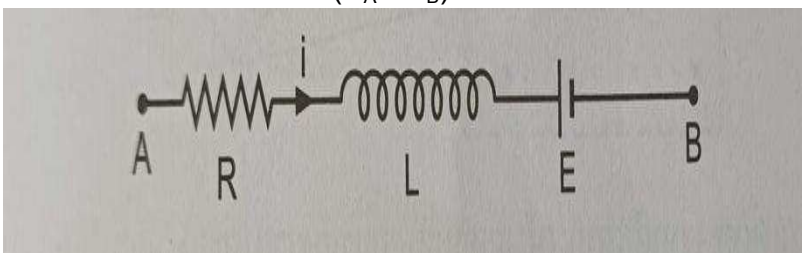
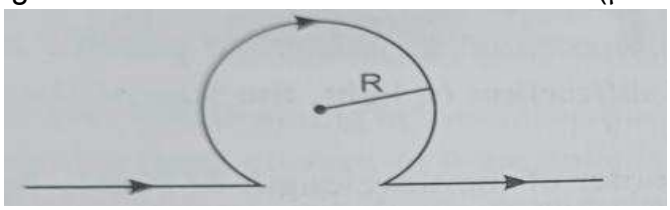
OSDAV Public School, Kaithal
Preboard Exam- 2024-25
Class : XII
Subject : Physics (Set - A)

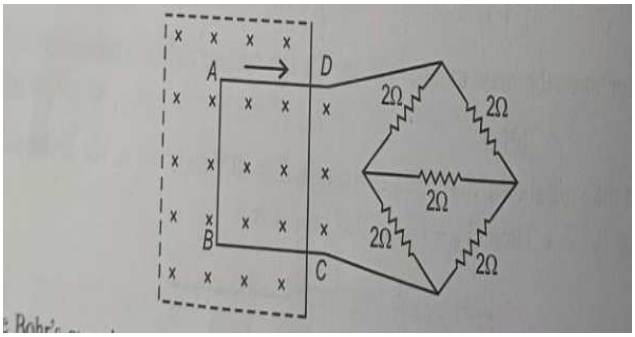
Time: **3 hr** M.M.: **70**

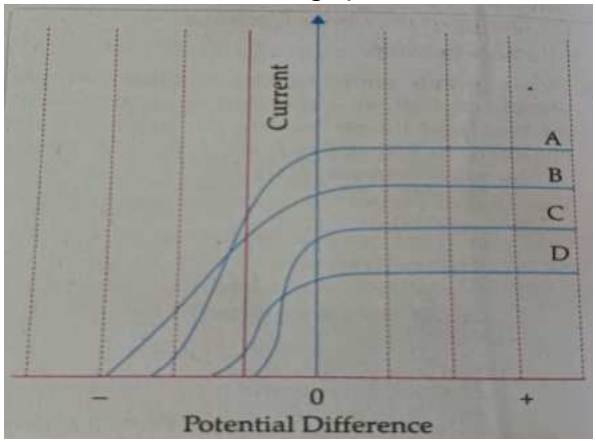
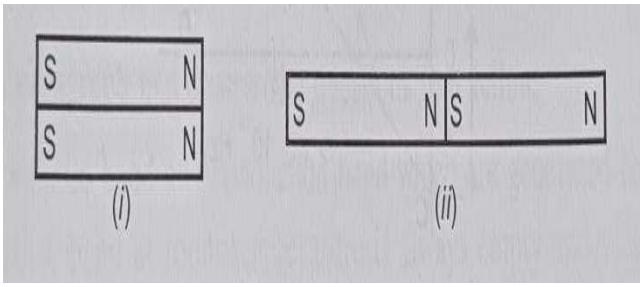
General Instructions:-

(1) *There are 33 questions in all. All questions are compulsory.*
(2) This question paper has five sections: Section A, Section B, Section C, Section D and E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.

Q. No	SECTION -A	Marks
1	An ammeter of resistance 0.81 ohm reads up to 1A. The value of the required shunt to increase the range to 10A is (A) 0.9 ohm (B) 0.09 ohm (C) 0.03 ohm (D) 0.3 ohm	1
2	The voltage across a resistor, an inductor, and a capacitor connected in series to an ac source are 20 V, 15 V and 30 V respectively. The resultant voltage in the circuit is (A) 5 V (B) 65 V (C) 25 V (D) 20 V	1
3	Electromagnetic waves travelling in a medium having relative permeability u_r =1.3 and relative permeability $\mathcal{E}_r$=2.14. The speed of electromagnetic waves in medium must be a) 1.8×10^8 m/s b) 1.8×10^4 m/s c) 3.6×10^8 m/s d) none of these	1
4	Ratio of the radii of the nuclei with mass number 8 and 64 would be a) 8 b) ⅛ c) 2 d) ½	1
5	A thin circular wire carrying a current I, has a magnetic moment M. The shape of a wire is changed into a square and it carries the same current. It will have magnetic moment a) $4M/\pi^2$ b) M c) $\pi M/4$ d) $4M/\pi$	1
6	A coil having 500 square loops of 10 cm is placed normal to magnetic field which increases at a rate of 1 T/s .The induced emf is a) 0.1 V b) 0.5 V c) 1 V d) 5 V	1
7	In terms of Rydberg constant R, the shortest wavelength in paschen series of hydrogen atom spectrum will have wavelength a) 1/R b) 4/R c) 3/2R d) 9/R	1
8	A straight wire of mass 200 g and length 1.5 m carries a current of 2 A. It is suspended in mid-air by uniform horizontal magnetic field B. The magnitude of B (in tesla) is (take g= 9.8 m/s^2) a) 2 b) 1.5 c) 0.55 d) 0.65	1
9	A particle is dropped from a height H .The de broglie wavelength of the particle as function of height is proportional to a)H b) $H^{1/2}$ c) $H^{-½}$ d) H^2	1

10	A ray of light travels from a medium into water at an angle of incidence of 18°. The refractive index of the medium is more than that of water and the critical angle for the interface between the two media is 20°. Which one of the following figures best represents the correct path of the ray of light?  	1
11	In the circuit diagram shown, R= 10 ohm, L= 5 mh, E= 10 V and i = 1 A. The current is decreasing at the rate of 10^3 A/s. Then $(V_A - V_B)$ at this instant is  a) 10 V b) 15 V c) 20 V d) 25 V	1
12	The strength of magnetic field at the centre of circular coil is (μ is absolute permeability)  a) $\frac{\mu I}{R}\left(1 - \frac{1}{\pi}\right)$ b) $\frac{\mu I}{\pi R}$ c) $\frac{\mu I}{2R}\left(1 - \frac{1}{\pi}\right)$ d) $\frac{\mu I}{R}\left(1 + \frac{1}{\pi}\right)$	1
	Q13 to 16 are Assertion Reason Questions. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below: ***a) Both A and R are true and R is the correct explanation of A.*** ***b) Both A and R are true and R is NOT the correct explanation of A.*** ***c) A is true but R is false.*** ***d) A is false and R is also false.***	
13	Assertion (A) : Conductivity of a semiconductor increases on doping with trivalent atoms. Reason (R) : Trivalent atom can easily donate electrons due to their less ionisation energy.	1

14	Assertion (A): The number of photoelectrons ejected from a metal increases if the intensity of the light source is increased for a frequency greater than the threshold frequency. Reason (R): An increase in the intensity of light increases the energy of each photon.	1
15	Assertion (A): A thin uncharged metallic plate placed in between the two charged plates of a capacitor results in an arrangement equivalent to two capacitors in a series combination. The equivalent capacitance of this combination stays the same irrespective of the position of the metallic plate in between the plates of the capacitor. Reason (R): The change in the position of the central metallic plate, results in the decrease in plate separation of one capacitor that is compensated by the increase in plate separation for the other.	1
16	Assertion(A): To observe Diffraction of light, the size of obstacle/ aperture should be of the order 10^{-7}m Reason(R): 10^{-7}m is the order of the wavelength of visible light.	1
	SECTION - B	
17	A metallic square loop ABCD of size 15cm and resistance 1.0 ohm is moved at uniform velocity of v m/s, in a uniform magnetic field of 2T, the field lines being normal to the plane of paper.The loop is connected to an electrical network of resistors, each of resistance 2 ohm. Calculate the speed of loop, for which 2 mA current flows in the loop.  	2
18	The primary coil of an ideal step up transformer has 100 turns and the transformation ratio is also 100. The input voltage and power are 220 V and 1100 W respectively. Calculate: a) Number of turns in secondary coil. b) The current in the primary coil c) The current in the secondary coil	2
19	State Bohr's quantization condition of angular momentum. Calculate the orbital period of the electron in the first excited state of hydrogen atom.	2
20	Violet light is incident on a converging lens of focal length f. State with reason, how the focal length of lens will change, if the violet light is replaced by red light.	2
21	Electromagnetic waves with wavelength (i) λ_1 is suitable for radar systems used in aircraft navigation. (ii) λ_2 is used to kill germs in water purifiers. (iii) $\lambda 3$ is used to improve visibility in runways during fog and mist conditions. Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude.	2

	SECTION - C	
22	Figure shows the variation of photoelectric current measured in a photo cell circuit as a function of the potential difference between the plates of the photo cell when light beams A, B, C and D of different wavelengths are incident on the photo cell. Examine the given figure and answer the following questions:  (i) Which light beam has the highest frequency and why? (ii) Which light beam has the longest wavelength and why? (iii) Which light beam ejects photoelectrons with maximum momentum and why?	3
23	Draw binding energy per nucleon curve and discuss it.	3
24	a) Calculate the force per unit length acting between two parallel wires of infinite extent separated by a distance 2 cm each carrying current of 4 A. b) Two identical bar magnets of magnetic dipole moment M each are arranged as shown in figure.  What will be the dipole moment in each case?	3
25	a) An a.c. source generating a voltage $E = E_0 \sin wt$ is connected to a capacitor of capacitance C. Find the expression for the current I flowing through it. b) A light bulb is rated at 100 W for a 220 V a.c. supply. Calculate the resistance of the bulb.	3
26	(a)A Young's double slit set up is illuminated with monochromatic light. If the intensity of light passing through one of the slits is reduced, explain the changes that can be seen in the appearance of the bright and dark fringes? (b) A single slit diffraction setup is illuminated with green light of wavelength 500 nm. If the width of the slit is 1 mm and the screen is 2 m away from the slits, calculate the width of the central maximum. (c)What will happen to the width of the central maximum, if the green light is replaced with the red light?	3

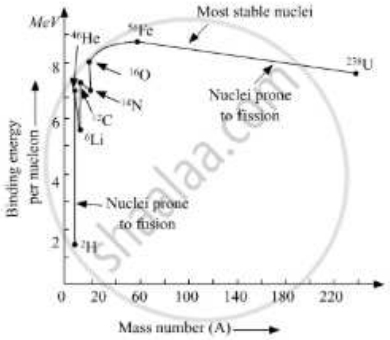
27	a) Define angle of minimum deviation in a glass prism. b) An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $\frac{4}{5}\sqrt{2}$	3
28	A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R_1 in series with the coil. If a resistance R_2 connected in series with it, then it can measure upto V/2 volts. Find the resistance, in terms of R_1 and R_2,required to be connected to convert it into a voltmeter that can read upto 2 V volts. Also find the resistance G of galvanometer in terms of R_1 and R_2.	3
	SECTION - D	
29	**The Bending of light around the corners of obstacles or aperture and spreading into the regions of geometrical shadow is called Diffraction of light. The size of obstacle or aperture should be of the order of wavelength of light used. Interference is the superposition of light waves from two different wavefront originating from the same source, while the Diffraction is the interaction of light waves from different parts of the same wave front** (i) The essential Condition for diffraction of light to occur is that size of the aperture a) must be less when compared to the wave length of light. b) must be more when compared to the wave length of light. c) must be comparable to the wave length of light. d) none of these (ii) Single slit diffraction is completely immersed in water without changing any other parameter. How is the width of central maximum affected? a) Insignificant b) Increases c) Decreases d) Becomes zero (iii) The main difference between interference and diffraction is a) Diffraction is due to interaction of light from the same wavefront whereas interference is interaction of waves from two isolated sources. b) Diffraction is due to interaction of light from the different wavefront whereas interference is interaction of two waves derived from same source. c) Diffraction is due to interaction of waves derived from the same source, whereas interference is bending of light from the same wave front. d) there is no difference between interference and diffraction (iv) The phenomenon of interference is based on a) Conservation of momentum b) Conservation of energy c) Conservation of momentum and energy d) quantum nature of light	4

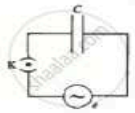
30	**Two bands namely valence band and condution band.which are generated by the interaction of atoms. The conduction band at room temperature is always empty and valence band is filled. There exists a band gap between the two bands.The band gap >3 eV is insulator. Eg between 0.2 eV and 3 eV is semiconductor but for metal Eg = 0 i.e., no gap between bands is seen and that's why they are called good conductors. By doping we can change the characteristic of the elements.** (i) An intrinsic semiconductor is converted into n- type Extrinsic semiconductor. by doping it with (a) germanium (b) phosphorus (c) aluminium (d) silver	4
30	(ii) In an n-type semiconductor, which of the following statements is true? (a) Electrons are majority carriers and trivalent atoms are dopants. (b) Electrons are minority carriers and pentavalent atoms are dopants. (c) Holes are minority carriers and pentavalent atoms are dopants. (d) Holes are majority carriers and trivalent atoms are dopants. (iii) In semiconductor at a room temperature (a) the valence band is partially empty and the conduction band is partially filled. (b) the valence band is completely filled and the conduction band is partially filled. (c) the valence band is completely filled. (d) the condution band is completely empty. (iv) At absolute zero, Ge acts as (a) non-metal (b) metal (c) insulator (d) semiconductor	
	SECTION - E	
31	a) Define the term electrostatic potential. Give the dependence of electrostatic potential due to a small electric dipole at a far off point lying on i) the axial line ii)Equitorial line b) Briefly explain the principle of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor.	5
32	a)A cell of emf E and internal resistance r is connected across a variable load resistor R. Draw the plots of terminal voltage V versus i) R and ii) the current I. b) Two cells of emfs $E_1$and E_2 and internal resistance r_1 and r_2 respectively are connected in parallel. Deduce the expression for i) The equivalent emf of combination. ii) The equivalent resistance of combination. iii) The potential difference between the point A and B.	5
33	a) Draw a ray diagram of compound microscope. Write the expression for its magnifying power. b) In a compound microscope an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye-piece has a focal length of 5 cm and the final image is formed at the near point, find the magnifying power of the microscope.	5

ANSWER-KEY
Physics XI [Set – A]

1	B	1
2	C	1
3	A	1
4	C	1
5	D	1
6	C	1
7	B	1
8	C	1
9	C	1
10	C	1
11	B	1
12	C	1
13	C	1
14	C	1
15	A	1
16	A	1
	SECTION-B	
17	Speed of loop=0.2m/s	2
18	(a) 10000 turns (b) 5A (c) 0.05A	2

19	According to De-brogile's wavelength associated with an electron ; $\lambda = \frac{h}{mv}$ .....1 and the standing wave condition that circumference = whole Number of wave length If 'n' is the nth orbit $\therefore 2\pi r = n\lambda n$....2 $\therefore$ since angular momentum $L = mvr$ from eqn (1) $L = \frac{hr}{\lambda}$ $= \frac{hr}{\left(\frac{2\pi r}{n}\right)}$ from 1 and 2 $\therefore L = \frac{nh}{2\pi}$ Bohr's Quantization condition	2
20	The refractive index of the material of a lens increases with the decrease in wavelength of the incident light. So, focal length will decrease with decrease in wavelength according to formula. $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ Thus, when we replace red light with a violet wavelength decrease and hence the focal length of the lens also decrease.	2
21	(I)λ, → Microwaves (Radar) (II) λ_2 → UV rays (Water Purification) (III) λ_3 → Infrared (Fog visibility). Order: $\lambda_2 < \lambda_3 < \lambda_1$	2
	SECTION-C	

22	**(i)** We know that the stopping potential and frequency are related as $V = \frac{(hf - \phi)}{q}$ Where Φ is the work function defined as the amount of energy needed to bind the electrons in the metals, hf is the energy of photons, and q is the charge. This relationship leads us to the conclusion that the greater negative the stopping potential, the higher the frequency. As a result, curve B has the highest frequency and the largest negative stopping potential in the graph. **(ii)** We all know that the connection between wavelength and frequency is inverse. The wavelength reduces as the frequency rises and vice versa. As can be seen from the graph, C has the lowest frequency out of all the possible values since its stopping potential is the least negative. Therefore, the wavelength is largest when the frequency is lowest. C has the longest wavelength as a result. **(iii)** Highest momentum means highest kinetic energy which can be calculated with the help of velocity. kinetic energy = $\frac{1}{2}mv^2$ Relation to the momentum, $p^2 = 2m(K.E.)$ If kinetic energy is maximum, then momentum will be maximum. We know that the stopping potential and frequency are related, $Vq = (hf - \Phi)$ The maximum kinetic energy of the electrons equals the stopping voltage when measured in electron volt. We can consider Φ as the kinetic energy. Kinetic energy is maximum when the frequency is maximum and in the above part we have seen that it is maximum for curve B, so momentum is maximum for curve B.	3
23	 The above curve tells us that the binding energy per nucleon is smaller for heavier nuclei as well as for lighter nuclei than for the middle order nuclei (with mass number lying between 30 to 170). Meaning heavier nuclei are less stable thus they undergo fission and lighter nuclei undergo fusion in order to form the nucleus lying in the range of the mass number 30 to 170.	3
24	(a) Force per unit length = 4×10^{-5} N/m (b) Dipole moments: M (parallel), M/2 (perpendicular).	3

25	(a) The following figure shows an AC source, generating a voltage $e = e_0 \sin \omega t$, connected to a capacitor of capacitance C. The plates of the capacitor get charged due to the applied voltage. As the alternating voltage is reversed in each half cycle, the  **An AC source connected to a capacitor** capacitor is alternately charged and discharged. If q is the charge on the capacitor, the corresponding potential difference across the plates of the capacitor is $V = \frac{q}{C} \therefore q = CV$. q and V are functions of time, with $V = e = e_0 \sin \omega t$. The instantaneous current in the circuit is $i = \frac{dq}{dt} = \frac{d}{dt}(CV) = C\frac{dV}{dt}$ $= C\frac{d}{dt}(e_0 \sin \omega t) = \omega C e_0 \cos \omega t$ $\therefore i = \frac{e_0}{(1/\omega C)} \sin\left(\omega t + \frac{\pi}{2}\right) = i_0 \sin\left(\omega t + \frac{\pi}{2}\right)$ where $i_0 = \frac{e_0}{(1/\omega C)}$ is the peak value of the current. (b) Here, $P = 100W, E_v = 220V,$ $R = ? E_0 = ? I_v = ?$ From, $P = \frac{E_v^2}{R}, R = \frac{E_v^2}{R} = \frac{220 \times 220}{100} = 484\Omega$	3
26	(a) Decreased contrast in interference fringes (b) Width = 2λD/a = 1 mm (c) Red light → Increased width.	3
27	(a) The minimum value of the angle of deviation suffered by a ray on passing through a prism is called the angle of minimum deviation. (b) When the prism is kept in another medium we have to take the refractive index of the prism with respect to the provided medium. $\text{medium}^{\mu} = \frac{\mu_{\text{prism}}}{\mu_{\text{medium}}} = \frac{\sin\left[\left(\frac{A+D_m}{2}\right)\right]}{\sin\left(\frac{A}{2}\right)}$ $\frac{1.6}{\frac{4\sqrt{2}}{5}} = \frac{\sin\left[\left(\frac{60^\circ+D_m}{2}\right)\right]}{\sin\left(\frac{60^\circ}{2}\right)}$ $\sqrt{2} = \frac{\sin\left[\left(\frac{60^\circ+D_m}{2}\right)\right]}{\frac{1}{2}}$ $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) = \left(\frac{60^\circ + D_m}{2}\right)$ $90^\circ = 60^\circ + D_m$ $D_m = 30^\circ$	3

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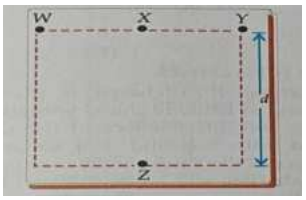
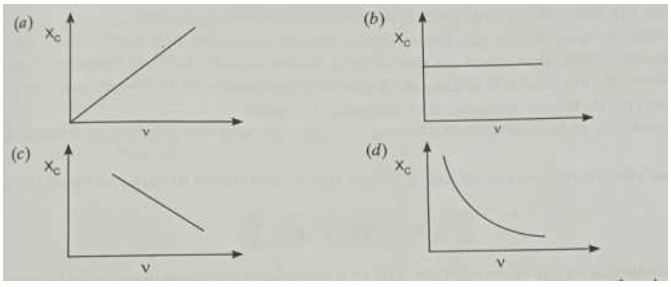
(1) ***There are 33 questions in all. All questions are compulsory.***

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

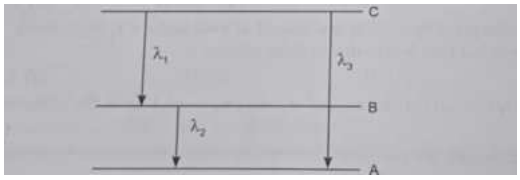
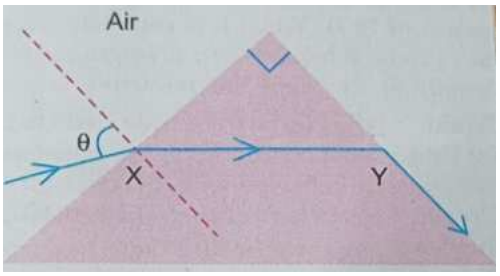
(3) All the sections are compulsory.

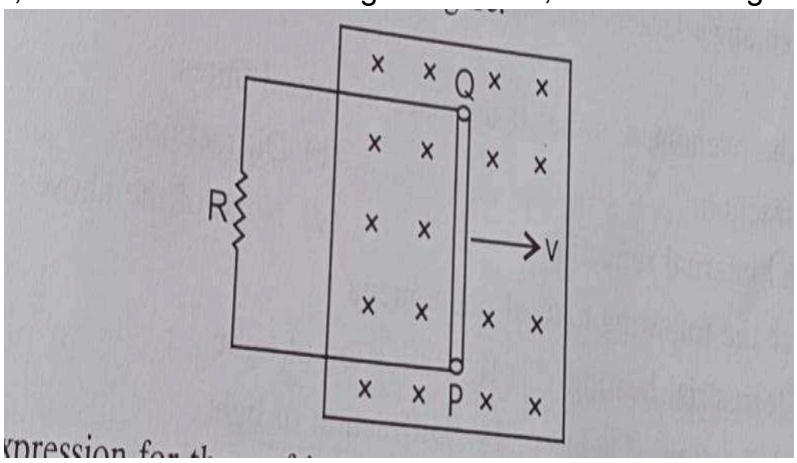
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.

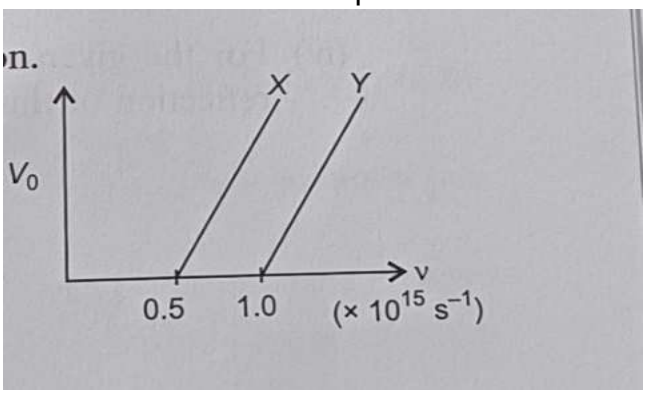
(5) There is no overall choice.

Q. No	SECTION -A	Marks
1	Four objects W,X,Y and Z each with charge +q are held fixed at four points of square of side d as shown in figure .Objects X and Z are on the mid points of sides of the square.The electrostatic force exerted by object W on object X is F. Then the magnitude of force exerted by object W on Z is  a) F/7 b) F/5 c) F/3 d) F/2	1
2	In a Young's double-slit experiment, the screen is moved away from the plane of the slits. be its effect on the followings: **(i) Angular separation of the fringes.** **(ii) Fringe-width.** (a) Both (i) and (ii) remain constant (b) (i) remains constant, but (ii) decreases. (c) (i) remains constant, but (ii) increases (d) Both (i) and (ii) increase.	1
3	The correct variation of capacitive reactance of a capacitor with frequency is represented by 	1

4	A thin circular wire carrying a current I, has a magnetic moment M. The shape of a wire is changed into a square and it carries the same current. It will have magnetic moment a) $4M/\pi^2$ b) M c) $\pi M/4$ d) $4M/\pi$	1
5	The figure shown represents part of a closed circuit. The potential difference between points A and B ($V_A - V_B$) is  a) +9 V b) -9 V c) +3 V d) +6 V	1
6	Two point charges +8q and -2q are located at x= 0 and x= L respectively. The point on x axis at which the net electric field is zero due to these charges is a) 8L b) 4L c) 2L d) L	1
7	Two particles A_1 and A_2 of masses m_1 and m_2 ($m_1 > m_2$) have the same de broglie wavelength. Then, a) their momenta are the same b) their energies are the same c) energy of $A_1 > A_2$ d)energy of $A_1 = A_2$	1
8	Ratio of the radii of the nuclei with mass number 8 and 27 would be a) 27/8 b) 8 /27 c) 2/3 d) 3/2	1
9	A magnetic needle suspended parallel to magnetic field requires $\sqrt{3}$ J of work to turn it through 60°. The torque needed to maintain the needle in this position will be **a)** $2\sqrt{3}$ J b) 3 J c) $\sqrt{3}$J d) 3/2 J	1
10	The relative permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then (a) X is paramagnetic and Y is ferromagnetic (b) X is diamagnetic and Y is ferromagnetic (c) X and Y both are paramagnetic (d) X is diamagnetic and Y is paramagnetic	1
11	A coil having 500 square loops of 10 cm is placed normal to magnetic field which increases at a rate of 1 T/s . The induced emf is a) 0.1 V b) 0.5 V c) 1 V d) 5 V	1
12	Electromagnetic waves travelling in a m.edium having relative permeability $u_r = 1.3$ and relative permeability $\varepsilon_r = 2.14$. The speed of electromagnetic waves in the medium must be a) 1.8×10^8 m/s b) 1.8×10^4 m/s c) 3.6×10^8 m/s d) none of these	1
	Q13 to 16 are Assertion Reason Questions. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below: *a) Both A and R are true and R is the correct explanation of A.* *b) Both A and R are true and R is NOT the correct explanation of A.* *c) A is true but R is false.* *d) A is false and R is also false.*	
13	Assertion(A): The potential inside a hollow Spherical charged conductor is zero. Reason (R): Inside the hollow spherical conductor electric field is constant.	1

14	Assertion (A): If the objective lens and the eyepiece lens of a microscope are interchanged, it works as a telescope. Reason (R): Objective lens of telescope require large focal length and eyepiece lens require small focal length.	1
15	Assertion (A) : For a particle to have de broglie wave associated with it, it must carry charge. Reasons (R): De broglie waves are electromagnetic in nature.	1
16	Assertion (A): Current drawn through a long wire of finite resistance connected across an ac generator decreases when that wire is wound into a coil of many loops. Reason (R): Inductor offers back emf to the time varying ac current whereas a resistor doesn't.	1
	SECTION - B	
17	Electromagnetic waves with wavelength (i) λ_1 is suitable for radar systems used in aircraft navigation. (ii) λ_2 is used to kill germs in water purifiers. (iii) λ_3 is used to improve visibility in runways during fog and mist conditions. Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude	2
18	Draw the graph showing the variation of binding energy per nucleon with mass number.Write inferences which can be drawn from this graph.	2
19	Find the relationship between the three wavelength λ_1, λ_2, λ_3 from the energy level diagram shown below. 	2
20	Derive capacitance of a parallel plate capacitor with area of cross section A, whose plates are distance d apart and having a dielectric slab of thickness t and constant K between the two plates.	2
21	A ray of light is incident at angle ¤ (Theta) on a right- angled prism at point X. At point Y, it emerges along the prism surface. Calculate the refractive index of the prism in terms of the incident angle. 	2
	SECTION - C	

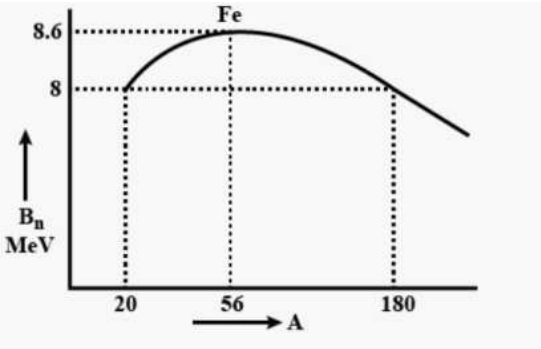
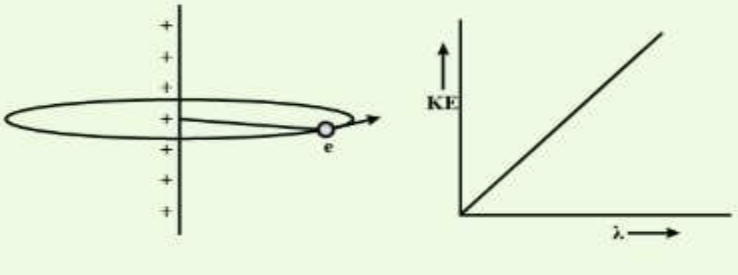
22	(a)An infinitely long Positively charged straight wire has a linear charge density ƛ C/m. An electron is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression of its kinetic energy. (b) Plot a graph of the kinetic energy as function of charge density ƛ .	3
23	A galvanometer of resistance G is converted into a voltmeter to measure upto V volts by connecting a resistance R_1 in series with the coil. If a resistance R_2 connected in series with it, then it can measure upto V/2 volts. Find the resistance, in terms of R_1 and R_2,required to be connected to convert it into a voltmeter that can read upto 2 V volts. Also find the resistance G of galvanometer in terms of R_1 and R_2.	3
24	A conducting rod PQ, of length l , connected to a resistor R, is moved at a uniform speed v, normal to a uniform magnetic field B,as shown in figure .  a) Deduce the expression for the emf induced in the conductor. b) Mark the direction of induced current in the conductor.	3
25	An alternating voltage of 220 V is applied across a device X. A current of 0.22 A flows in the circuit and it lags behind the applied voltage in phase by pi/2 radian. When the same voltage is applied across another device Y, the current in the circuit remains the same and it is in phase with the applied voltage. (i) Name the devices X and Y and, (ii) Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.	3
26	(a)A Young's double slit set up is illuminated with monochromatic light. If the intensity of light passing through one of the slits is reduced, explain the changes that can be seen in the appearance of the bright and dark fringes? (b) A single slit diffraction setup is illuminated with green light of wavelength 500 nm. If the width of the slit is 1 mm and the screen is 2 m away from the slits, calculate the width of the central maximum. (c)What will happen to the width of the central maximum, if the green light is replaced with the red light?	3

27	The following graph shows the variation of stopping potential V_0 with the frequency υ of incident radiation for two photosensitive metal X and Y.  a)Which of the metals has larger threshold wavelength? Give reason. b) Explain, giving reason, which metal gives out electrons, having large kinetic energy, for the same wavelength of incident radiation. c)If the distance between the light source and metal X is halved, how will the kinetic energy of electrons emitted from it change ? Give reason.	3
28	Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.	3
	SECTION - D	
29	When two thin lenses of focal length f_1 and f_2 are placed in contact with each other along their common principal axis, then the two lens system is regarded as a single lens of focal length f and $1/f = 1/f_1 + 1/f_2$ i) Two thin lenses are kept coaxially in contact with each other and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, the focal length of the other would be a) -26.7cm b) 60 cm c) 80 cm d) 30 cm ii)A spherical air bubble is embedded in a piece of glass. For a ray of light passing through a bubble, it behave like a a) Converging lens b) Diverging lens c) Mirror d)Thin plate sheet of glass iii) The magnification of an image by a convex lens is positive only when the object is placed a) at its focus b). between F and 2F c) at 2F d) between F and optical centre iv) A convex lens of 20 cm focal length forms a real image which is three times magnified. The distance of the object from the lens is a) 13.33 cm. b) 14 cm. c) 26.66 cm. d) 25 cm	4

30	A p- n junction is the basic building block of many semiconductor devices like diodes. Important process occurring during the formation of p-n junction are diffusion and drift. In an n - type semiconductor, concentration of electrons is more as compared to holes. In a p- type semiconductor, concentration of holes is more as compared to electrons. i)In a semiconductor crystal, if the current flows due to breakage of crystal bonds, then the semiconductor is called a) acceptor b) Donor c) Intrinsic semiconductor d) Extrinsic semiconductor ii) The energy gap between valence band and condution band in insulator is about a) 0.15 eV b) 1 eV c) 2 eV d) 3.5 eV iii) In an unbiased p-n junction a) High potential is at n side and low potential is at p - side. b) High potential is at p- side and low potential is at n - side. c) p and n both are at same potential d) Potential can not be determined. iv) The increase in the width of depletion region in a p- n junction diode is due to a) Reverse bias only b) Both forward bias and reverse bias c) Increase in forward current d) Forward bias only.	4
	SECTION - E	
31	(i) Draw a ray diagram to show the working of a compound microscope. Obtain the expression for the total magnification for the final image to be formed at the near point. (ii) In a compound microscope an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye-piece has a focal length of 5 cm and the final image is formed at the near point, find the magnifying power of the microscope.	5
32	a) State Gauss ‘s law . Use it to Deduce the expression for electric field due to a uniformly charged thin spherical shell at points i) inside and ii) outside the shell. Draw E (electric field) verses r (distance) graph. b) Two charged conducting spheres of radii a and b are connected to each other by a wire. Find the ratio of the electric fields at their surfaces.	5
33	a)A cell of emf E and internal resistance r is connected across a variable load resistor R. Draw the plots of terminal voltage V versus i) R and ii) the current I. b) Two cells of emfs E_1 and E_2 and internal resistance r_1 and r_2 respectively are connected in parallel. Deduce the expression for i) The equivalent emf of combination. ii) The equivalent resistance of combination. iii) The potential difference between the point A and B.	5

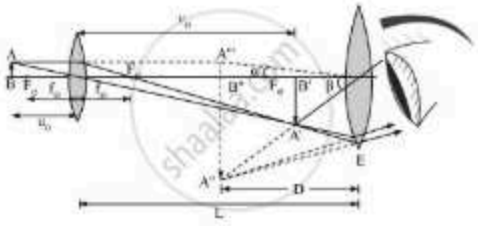
ANSWERKEY
Physics XI [Set – B]

1	C	1
2	C	1
3	C	1
4	A	1
5	B	1
6	B	1
7	C	1
8	C	1
9	D	1
10	D	1
11	C	1
12	A	1
13	C	1
14	A	1
15	D	1
16	A	1
	SECTION-B	
17	(I)λ, → Microwaves (Radar) (II) λ_2 → UV rays (Water Purification) (III) λ_3 → Infrared (Fog visibility). Order: $\lambda_2 < \lambda_3 < \lambda_1$	2

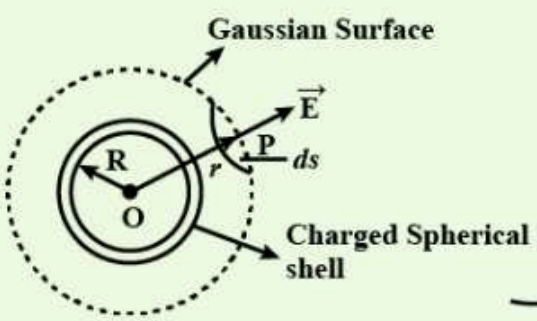
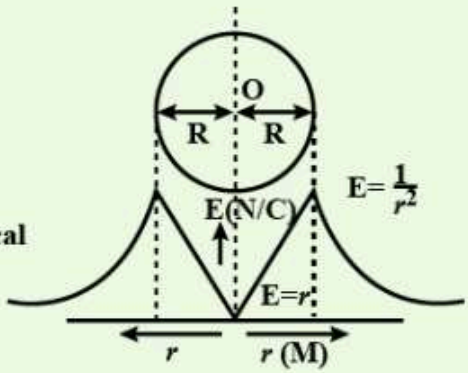
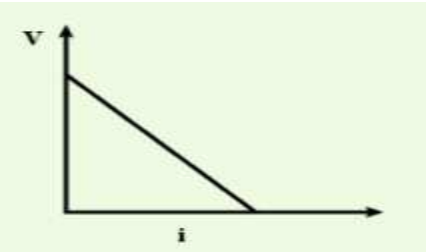
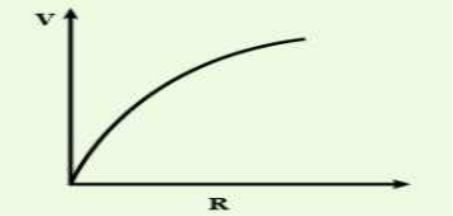
18	 The graph of the binding energy per nucleon versus mass number A is shown in figure. The decrease of the binding energy per nucleon for nuclei with high mass number is due to increased coulomb repulsion between protons inside the nucleus.	2
19	Relationship: $\lambda_1 < \lambda_2 < \lambda_3$ (based on energy transitions in the diagram).	2
20	Derivation: C = (εA / d) (if no dielectric), modified by K for thickness t.	2
21	Refractive Index (n) = sin(0) / sin(90 - 0) using Snell's law.	2
	SECTION-C	
22	(a) Infinitely long charged wire produces a radical electric field. $E = \frac{\lambda}{2\pi\epsilon_0 r} \ldots\ldots (1)$ The revolving electron experiences an electrostatic force and provides necessarily centripetal force. $eE = \frac{mv^2}{r} \ldots\ldots (2)$ $\frac{e.\lambda}{2\pi\epsilon_0 r} = \frac{mv^2}{r} \Rightarrow mv^2 = \frac{e\lambda}{2\pi\epsilon_0}$ Kinetic energy of the electron, $K = \frac{1}{2}mv^2 = \frac{e\lambda}{4\pi\epsilon_0}$ (b) the graph is shown above, (a straight line passing through origin). 	2 1

23	Let the resistance of the galvanometer be R_G. Let maximum current carrying capacity be I. From the given data, $V = I(R_G + R_1)$ $\frac{V}{2} = I(R_G + R_2)$ From the equations, $2 = \frac{R_G + R_1}{R_G + R_2}$ $R_G = R_1 - 2R_2$ Let the resistance required to read 2V be R_3 $2V = I(R_G + R_3)$ $2(R_G + R_1) = R_G + R_3$ $R_3 = R_G + 2R_1$ $R_3 = 3R_1 - 2R_2$	1 1 1
24	Emf = Bℓv (Faraday's Law), (b) Induced current direction via Lenz's Law.	3
25	a. X is a resistor and Y is the capacitor. b.  $R = \frac{V_{rms}}{I_{rms}} = \frac{220}{0.22} = 1000\Omega$ $R = X_C = 1000\Omega$ When R and C are in series. $I_{rms} = \frac{V_{rms}}{Z} = \frac{V_{rms}}{\sqrt{R^2 + (X_C)^2}}$ $= \frac{220}{\sqrt{(1000)^2 + (1000)^2}}$ $= \frac{220}{1000 \times \sqrt{2}}$ $I_{rms} = 0.156\ A$	1 2
26	(a) Decreased contrast in interference fringes (b) Width = 2λD/a = 1 mm (c) Red light → Increased width.	1 1 1
27	(a) Metal with smaller cutoff frequency has a larger threshold wavelength (b) Metal with larger stopping potential gives higher KE (c) No change (Intensity affects photoelectric current, not KE).	1 1 1

28	The relationship between the relaxation time (τ) and drift velocity (v_d) is given by: $v_d = -e\left(\frac{E\tau}{m}\right)$ $\therefore \tau = \frac{(v_d m)}{e} \times E$ Let L = Length of the conductor A = Area of the conductor n = free electron density e = charge of the electron E = Electric field m = mass of the electron τ = Relaxation time The current flowing through the conductor is $I = neAv_d$ $I = neA\left(\frac{eE}{m}\right)\tau$ Also, field E can be expressed as $E = \frac{V}{L}$ The current flowing through the conductor is: $I = \frac{ne^2VA\tau}{mL}$ or $\frac{V}{I} = \frac{mL}{ne^2\tau A}$ or $R = \frac{mL}{ne^2\tau A}$ ...$\left(\text{from Ohm's law}\frac{V}{I} = R\right)$ or $R = \frac{m}{ne^2\tau}\left(\frac{L}{A}\right)$ Electrical resistivity, $\rho = \frac{m}{ne^2\tau}$ ...$\left[\because R = \rho\frac{L}{A}\right]$	
	SECTION-D	
29	(I) A (II) B (III)D (IV)A	1 1 1 1
30	(I) C (II) D (III)B (IV)A	1 1 1 1
	SECTION-E	

31	**Ray diagram for a compound microscope**  Total angular magnification, $m = \frac{\beta}{\alpha}$ $\beta \rightarrow$ Angle subtended by the image $\alpha \rightarrow$ Angle subtended by the object Since α and β are small, $\tan\alpha \approx \alpha$ and $\tan\beta \approx \beta$ $m = \frac{\tan\beta}{\tan\alpha}$ $\tan\alpha = \frac{AB}{D}$ And $\tan\beta = \frac{A''B''}{D}$ $m = \frac{\tan\beta}{\tan\alpha} = \frac{A''B''}{D} \times \frac{D}{AB} = \frac{A''B''}{AB}$ On multiplying the numerator and the denominator with A'B', we obtain $m = \frac{A''B'' \times A'B'}{A'B' \times AB}$ Now, magnification produced by objective, $m_0 = \frac{A'B'}{AB}$ Magnification produced by eyepiece, $m_e = \frac{A''B''}{AB}$	3

31 (B)	Total magnification, $(m) = m_0\, m_e$ $m_0 = \frac{V_0}{u_0} = \frac{\text{Image distance for image produced by objective lens}}{\text{Object distance for the objective lens}}$ $m_e = \left(1 + \frac{D}{f_e}\right)$ $f_e \rightarrow$ Focal length of eyepiece $m = m_0 m_e$ $= \frac{V_0}{u_0}\left(1 + \frac{D}{f_e}\right)$ $V_0 \approx L$(Separation between the lenses) $u_0 \approx -f_0$ $\therefore m = \frac{-L}{f_0}\left(1 + \frac{D}{f_e}\right)$ $u_0 = -1.5cm$ $f_0 = +1.5cm$ $\frac{1}{f_0} = \frac{1}{v_0} - \frac{1}{u_0}$ $\frac{1}{1.25} = \frac{1}{v_0} + \frac{1}{1.5}$ $\frac{1}{v_0} = \frac{1}{1.25} - \frac{1}{1.5}$ $= \frac{100}{125} - \frac{10}{15}$ $= \frac{1500 - 1250}{1875}$ $\frac{1}{v_0} = \frac{250}{1875}$ $v_0 = +7.5cm$ $f_e = +5cm$ $m = \frac{v_0}{u_0}\left(1 + \frac{D}{f_e}\right)$ $= \frac{7.5}{-}1.5\left(1 + \frac{25}{5}\right)$ $= -\frac{7.5}{1.5} \times 6$ $m = -30$	2

32	(i) At a point P outside the spherical shell : Let $\vec{E}$ be the electric field at P. The electric field through an elemental surface $\vec{ds}$ is $d\phi = \vec{E} . \vec{ds}$ ∴ Total electric flux through the gaussian surface is $\phi = \oint_S E ds = E \oint_S ds = E \times 4\pi r^2$ $\phi = \frac{q}{\epsilon_0}$ $E \times 4\pi r^2 = \frac{q}{\epsilon_0}$ $E = \frac{1}{4\pi\epsilon_0} . \frac{q}{r^2}$ (for r > R) (ii) At a point P inside the spherical shell: In this case charge enclosed =0 $E \times 4\pi r^2 = 0$ E = 0 (for r < R)  	5
33 (A)	(I)  (II) 	1 1

33 (B)	• **Equivalent EMF:** $E_{\text{eq}} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$ • **Equivalent Internal Resistance:** $r_{\text{eq}} = \frac{r_1 r_2}{r_1 + r_2}$ • **Potential Difference Across A and B:** $V_{AB} = E_{\text{eq}} \times \frac{R}{R + r_{\text{eq}}}$	1 1 1